REMARKS

This application has been reviewed in light of the Office Action dated November 17, 2003. Claims 1-26 are in the application; claims 19-26 have been withdrawn from consideration by the Examiner. Claims 1-18 are presented for examination. Claim 1 is the only independent claim now under consideration. Favorable review is respectfully requested.

Claims 1-18 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. The rejection is respectfully traversed. Independent claim 1, which has not been amended herein, is reproduced below for the Examiner's convenience:

A method comprising:

a) depositing a multilayer structure on a semiconductor substrate, the multilayer structure including a first layer comprising titanium and in contact with the substrate, a second layer overlying the first layer and comprising an element selected from the group consisting of cobalt, tungsten, tantalum, and molybdenum, and a third layer comprising titanium overlying the second layer, in which the amount of the element does not exceed 20 atomic percent of the total amount of the element and titanium present in the multilayer structure; and

b) annealing the substrate and the structure in a nitrogen-containing atmosphere at about 500 °C to about 700 °C to form a first silicide layer including the element in contact with the substrate and a second silicide layer including titanium and the element overlying the first silicide layer.

The Examiner states that it is unclear how the element can be in contact with the substrate (lines 9-10 of the claim) since the first layer is in contact with the substrate (line 3) and is located between the element and the substrate. The applicants wish to point out that claim 1 is a method claim, where in step a) a multilayer structure is deposited on the substrate, and in step b) the substrate and the structure are annealed. The annealing is done to form a first silicide layer in contact with the substrate and a second silicide layer overlying the first silicide layer. The first silicide layer and the second silicide layer are thus formed from the

multilayer structure by the annealing step. As taught in the specification (page 12, line 13, to page 13, line 17), the multilayer structure shown in Figure 8 is changed by the annealing into the structure shown in Figure 9. Details of how this occurs (for the particular embodiment discussed in the specification) are given on page 13, lines 18-25. Stated another way, the "element" recited in the claim is included in the second layer of the as-deposited structure (step (a) of the claim), and is included in the first silicide layer formed by the anneal (step (b) of the claim), which is in contact with the substrate.

It therefore is respectfully submitted that the depositing and annealing steps, as presently recited, particularly point out and distinctly claim the subject matter regarded as the invention. Withdrawal of the rejection is earnestly requested.

Claims 1-18 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Rathore et al. (U.S. Pat. No. 6,069,068) in view of Farahani et al. (U.S. Pat. No. 5,612,253). The applicants respectfully submit that independent claim 1 is patentable over the art cited by the Examiner, for the following reasons.

The present invention, as defined in claim 1, is directed to a method including the step of depositing a multilayer structure on a semiconductor substrate; the first and third layers include titanium and the second layer includes an element selected from the group consisting of cobalt, tungsten, tantalum, and molybdenum. As noted above, the method also includes the step of annealing the substrate and the structure in a nitrogen-containing atmosphere, to form a first silicide layer including the element in contact with the substrate and a second silicide layer including titanium and the element overlying the first silicide layer.

It is thus a feature of the present invention that layers of silicide are formed by the annealing step. In particular, the element (selected from Co, W, Ta and Mo) is included in the first silicide layer in contact with the substrate; furthermore, the second silicide layer includes titanium and this element.

Rathore et al. describes a multilayer deposition process in which a layer possibly including titanium is deposited on the substrate, and an optional layer which may include Ta or W is deposited on the first layer. As noted by the Examiner, Rathore et al. does not teach or suggest any annealing process. In particular, Rathore et al. does not suggest any process in

which a silicide is formed, let alone a layer of silicide including Co, W, Ta or Mo which is in contact with the substrate.

Farahani et al. is understood to disclose a method for forming a trilayer structure including titanium, titanium nitride and titanium silicide by using a three-step annealing process. Farahani et al. does not suggest forming a silicide which includes titanium and another element, as in the present invention. In particular, Farahani et al. does not suggest forming a second silicide layer overlying the first silicide layer, where the second silicide includes titanium and an element selected from the group consisting of Co, W, Ta and Mo. Accordingly, Farahani et al. does not disclose or suggest the above-described features of the present invention.

With regard to a combination of the references, "obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art." MPEP § 2143.01. Rathore et al. is concerned with forming a copper intermetallic from the top layer (the last-deposited layer 7; col. 8, lines 33-37). Farahani et al., by contrast, is concerned with forming a nitride layer by annealing in a nitrogen-containing atmosphere. As noted above, Rathore et al. makes no suggestion regarding annealing, and in particular does not suggest forming a silicide layer in contact with the substrate by annealing. "The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification." *See In re Fritch,* 23 USPQ 2d 1783-84. There is no suggestion in Rathore et al. that an annealing step is desirable after a three-layer deposition; furthermore, Rathore et al. does not suggest that formation of either a silicide or a nitride is desirable. On the other hand, there is no suggestion or motivation in Farahani et al. to deposit over the titanium an additional layer including any of Co, W, Ta or Mo. It follows that Farahani et al. does not offer any motivation to form a silicide layer containing such an element. Accordingly, it would not have been obvious to combine the two references to arrive at the present invention. Even if one were to do so, the combination would not yield the present invention, as detailed below.

The Examiner states that "these features [formation of silicide layers by annealing] are inherent in the device of Farahani et al. and Rathore et al., because Farahani et al. and Rathore et al.'s structure is identical to the claimed structure, and the effect of annealing would be similar on both structures." This statement is respectfully not understood by the applicants. Annealing (let alone the annealing recited in claim 1) is clearly not an inherent feature of any process taught by Rathore et al. The structures disclosed by Rathore et al. and Farahani et al. also are by no means identical. Rathore et al. teaches a two-layer (optionally, three-layer) structure in which the top layer is chosen to be capable of forming an intermetallic with copper (col. 8, lines 32-36). Farahani et al. teaches a single Ti layer which is subjected to a multi-step annealing, resulting in a nitrided layer at the top and a silicide layer in contact with the substrate (col. 7, lines 32-43, and Figures 5a-5c). Furthermore, it is by no means clear from the references that annealing would have a similar effect on both structures. Farahani et al. offers no suggestion as to how annealing would affect the multi-layer structure of Rathore et al. One reading both references might be led to conclude that the annealing of Farahani et al. would cause some nitridation of the top layer 7 of Rathore et al. (assuming such layer was of titanium), and a silicide formed from the bottom layer 5 (although this layer could be any of a number of metals as taught by Rathore et al.). Even so, the result would not be a silicide layer including the element (selected from the group consisting of Co, W, Ta or Mo) previously deposited as part of the second layer, as required by the present invention.

Combining the deposition sequence of Rathore et al. with the annealing steps of Farahani et al. would theoretically yield a process for depositing a three-layer structure on a substrate (layers 5, 6 and 7 of Rathore et al.), followed by nitridation of the upper layer as taught by Farahani et al. This would render the upper layer unsuitable for forming a copper intermetallic (the desired result according to Rathore et al.). This in turn means that the required motivation to combine the references is lacking: "If the proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification." MPEP § 2143.01; *In re Gordon*, 733 F.2d 900 (Fed. Cir. 1984).

In view of the foregoing, it is submitted that the structures of Rathore et al. and Farahani et al. are not identical, and that there is no suggestion from Rathore et al. that annealing should be performed on a multi-layer structure. With regard to applying the annealing of Farahani et al. to the structure of Rathore et al., "it is impermissible to use the claimed invention as an instruction manual or 'template' to piece together the teachings of the prior art so that the claimed invention is rendered obvious." *In re Fritch*, 23 USPQ 2d 1783-84. It is respectfully submitted that the Examiner has engaged in hindsight to apply the annealing of Farahani et al. to the structure of Rathore et al. Even so, as noted above, such a combination would not have produced the present invention.

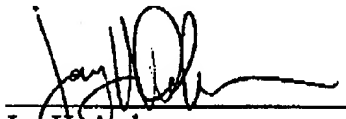
Accordingly, it is submitted that the cited references should not be combined as a reference against the present invention. It follows that the present invention would not have been obvious therefrom.

The other claims presently under consideration in this application are each dependent from the independent claim discussed above and are therefore believed patentable for the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual consideration of each on its own merits is respectfully requested.

In view of the foregoing amendments and remarks, the applicants respectfully request favorable consideration and early passage to issue of the present application.

The applicants' undersigned attorney may be reached by telephone at (845) 894-3667. All correspondence should continue to be directed to the below listed address.

Respectfully submitted,



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